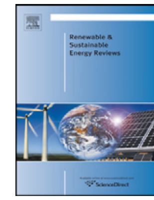
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Comparative assessment of policies targeting energy use efficiency in Lithuania

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ABSTRACT

Energy efficiency is an important issue of European climate policy. Energy efficiency is measured by the energy intensity of an economy showing how much energy (expressed in kilograms of oil equivalent, kgoe) is used for the production of one unit (1000 EUR) of GDP. There are huge differences between EU old and new member states. Though there are some trends of energy intensity convergence between EU member states however the achieved decrease in energy intensity is attributable mostly to a loss of energy-intensive industrial capacities in the transformation process. There is a crucial difference between whether the energy intensity of a given economy decreases as a result of downscaling energy-intensive activities or because of increased energy efficiency in activities that are maintained. It is important to make sure that this distinction is made within the policy framework which at present is not the case. The aim of the paper is to assess policies targeting energy intensity decrease in Lithuania in terms of efficiency, effectiveness and efficacy and to select the best policies able to increase energy efficiency in activities that are maintained.

Contents

1. Introduction

The energy efficiency policies here examined are just one type of energy policy, namely that serving environmental goals of less pollution and less resource depletion by enabling the same economic benefit with less input. Energy efficiency is essential in making the world energy system more sustainable. It reduces local air pollution and global climate change, while improving the security of energy supply and making modern energy affordable for the entire world population. In this way energy efficiency is essential to attenuate the impact from global warming. Efficiency improvements can drastically alter primary energy demand. In the last decades, energy efficiency has already made considerable progress; without the implemented measures energy use would already have been 50% higher than today. But as economies in the world grow, the world energy demand increases dramatically.

For evaluating the success of policies regarding energy efficiency three main categories can be distinguished: effectiveness, efficacy and cost efficiency. The effectiveness of policies is determined mainly by whether the right targets were set and the right measures were taken. The achievement of the set targets shows the efficacy. The evaluation therefore should focus on those two issues

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to determine whether the attained impact relates to the desired effects. The overall goal of introducing policies is to reach targets in the most economical way. Regarding the evaluation this means that the measured effects should be weighed against the deployed means, which in most cases means the costs. In this regard it could be helpful to compare the results and perform a benchmark with other policy instruments.

The aim of the paper is to assess energy efficiency policies in Lithuania in terms of effectiveness, efficiency and efficacy. The main tasks to achieve this target are:

- To analyze EU policy targeting increase in energy efficiency.
- To overview energy sector and energy intensity trends in Lithuania.
- To analyze policies and measures targeting energy efficiency increase in Lithuania.
- To carry out comparative assessment of policies targeting energy efficiency in Lithuania.
- To select the best energy efficiency policies for Lithuania lop recommendations for their implementation.

2. EU policy targeting increase in energy efficiency

The EU has set itself the objective of achieving 20% primary energy savings in 2020 and has made this objective one of the five headline targets of the Europe 2020 strategy for smart, sustainable and inclusive growth [1]. The energy efficiency target is part of one of the five headline targets under strategy 2020. It consistent with the Europe 2020 flagship initiative for a resource-efficient Europe and complementary with EU climate policy. Threfore energy efficiency is one of the central objectives for 2020 as well as a key factor in achieving our long-term energy and climate goals. Energy efficiency is the most cost effective way to reduce emissions, improve energy security and competitiveness, make energy consumption more affordable for consumers as well as create employment, including in export industries.

On 10 January 2007 the commission adopted an energy and climate change package, calling on the Council and European Parliament to approve: an independent EU commitment to achieve a reduction of at least 20% in the emission of greenhouse gases by 2020 compared to 1990 levels and the objective of a 30% reduction by 2020, subject to the conclusion of a comprehensive international climate change agreement; a mandatory EU target of 20% renewable energy by 2020 including a 10% biofuels target. The EU Green paper on European Strategy for Sustainable, Competitive and Secure Energy (SEC (2006) 317) sets the main priorities for EU energy strategy: competitiveness of the EU economy, security of supply and environmental protection. These objectives should help to address central policy concerns such as job creation, boosting overall productivity of the EU economy, protection of the environment and climate change. The first point of new amended EU Energy strategy adopted in 2010 focuses on achieving an energy efficient Europe [2].

The Commission's Green Paper on energy efficiency COM (2005) 265 stresses the importance of energy efficiency improvement for the controlling of demand growth and security of supply. According to estimates, the economic potential for improving energy efficiency in 2010 for all sectors combined is 20% of the total annual primary energy consumption of the current level. There are several directives aiming to implement Commissions Green Paper on energy efficiency: 2006/32/EC Directive on energy end-use efficiency and energy services, 2004/8/EC Directive on the promotion of cogeneration, Directive 2010/31/EC on the energy performance of buildings and the Directive 2010/30/EU on energy labeling.

The 2006/32/EC Directive on energy end-use efficiency and energy services sets the targets for EU member states to reduce final energy consumption by 9% during the nine year period until 2015 and proposes set of measures to achieve these targets: voluntary agreements, white tradable certificates, energy service obligations, energy audits etc. This directive requires Member States to submit the Action Plans describing the results of achieving the energy saving targets. The Action Plan also presents an overview of the current energy consumption situation and describes newly adopted and envisaged energy efficiency measures aimed at the improvement of energy efficiency that must ensure the achievement of the national energy savings target for 2016.

2002/91/EC Directive on the energy performance of buildings sets target to realize a savings potential of around 22% by 2010 for energy used in heating, air-conditioning, hot water and lighting. This directive was repealed by 2010/31/EC directive. According this Directive Member States shall take the necessary measures to ensure that minimum energy performance requirements for buildings or building units are set with a view to achieving cost-optimal levels. The main measures proposed for achieving this target are: improved standards, certification of buildings and information on energy consumption in buildings disclosure, subsidies form EU Structural Funds for energy efficiency improvements in public buildings, the incentive billing of residents of the buildings, soft loans for energy efficiency improvements in multi-flat buildings etc.

2004/8/EC Directive on the promotion of cogeneration based on a useful heat demand in the internal energy market aims to increase energy efficiency and improve security of supply by creating a framework for promotion and development of high efficiency cogeneration of heat and power based on useful heat demand and primary energy savings taking into account the specific national circumstances especially climate and economic conditions. The strategic goal of EU-15 is to double the share of electricity produced by combined heat and power pants (CHP) by 2010. The different mechanisms can be applied to support cogeneration at the national level, including investment aid, tax exemptions or reductions, green certificates and direct price support schemes, information disclosure etc.

Directive 2010/30/EU on energy labeling establishes a framework for the harmonization of national measures on end-user information, particularly by means of labeling and standard product information, on the consumption of energy and where relevant of other essential resources during use, and supplementary information concerning energy-related products, thereby allowing end-users to choose more efficient products.

In 2008, the EU adopted the Strategic Energy Technology Plan (SET-Plan), now in its implementation stage. This plan is the energy technology policy of the European Union. Despite having been initially focused on power technologies, the European Commission has now received the mandate to investigate the role of technological innovation to achieve a more efficient energy intensive industry and with less CO_2 emissions [3].

The EU also has an indicative cap in the 'Energy services directive' (2006/32/EC, ESD): each member-state should cut final energy consumption in sectors not covered by the Emissions Trading Scheme (ETS) by 9% (from the average consumption over the previous 5 years) by 2016. This target is not adjusted for differences in temperature (more fuel is used for heating in extremely cold winters and more electricity for air conditioning in hot summers) or industrial changes such as shifts from manufacturing to services. Generally, services sectors use a lot less energy per unit of output than those in manufacturing. Most member-states' economies have shifted toward less energy intensive sectors. The EU needs to focus on increasing not only the efficiency with which energy is consumed, but also the way it is supplied. The

biggest room for improvement exists in combined heat and power generation [3].

The progress report on the implementation of the EU Energy Efficiency Action Plan (EEAP) [4] clearly found that without further concerted action the European Union would be unlikely to meet the 2020 target to reduce energy consumption through energy efficiency by 2020. The new Energy Efficiency Plan 2011 [5] does not therefore replace the EEAP, it seeks to build upon the policies and experience under the EEAP and proposes additional measures to propel the EU toward meeting the 2020 targets. The new energy efficiency action plan was adopted by EC in 2011. As well as proposals to improve the energy efficiency of existing buildings, the plan includes the specific and ambitious proposals for much stronger regulation of energy supply. Priority areas identified by the Energy Efficiency Plan 2011 include: developing national measures and promotion systems in the Member States to trigger private sector renovation; bring forward draft legislative proposals from the European Commission to require Member States to address the issue of split incentives in the private rental sector. The European Commission will continue to set stricter standards with regard to the energy consumption of a broad range of appliances. The European Commission will bring forward draft legislation to require that in appropriate circumstances Member States make the authorization of new power generation conditional upon it being Combined Heat and Power to improve the efficiency of power generation. Ensure that the roll out of smart grids and meters is used to provide consumers with the information necessary to optimize energy use.

On 22 June 2012 the European Commission released the proposal for a new directive on energy efficiency [6]. The directive aims to help member states step up efforts to use energy more efficiently at all stages: from the generation and transformation of energy to its distribution and consumption. The scope of two directives: the Cogeneration Directive (2004/8/EC, CHP Directive) and the Energy Services Directive (2006/32/EC, ESD) overlap with this proposal. Both have failed to fully tap the energy saving potential. Therefore, it is proposed that these two directives are repealed when the new directive enters into force. Other provisions overlapping with the provisions of the new directive are Article 9(1) and (2) of Directive 2010/30/EU on energy labeling.

Lithuania as EU member state from 2004 have implemented EU directives and other regulations in the area of energy efficiency improvement and has policies and measures targeting energy efficiency increase in main sectors of economy however some policies especially in households sector are lacking in Lithuania. The main problem is harmonization of policies targeting energy efficiency, climate change mitigation and assessment of efficiency, effectiveness and efficacy of policies.

3. Energy sector overview and energy intensity trends in Lithuania

Lithuanian energy sector distinguished with huge energy generation capacities overcoming national energy demand until 2010. However the closure of Ignalina Nuclear Power Plant (NPP) in the end of 2009 drastically changed the situation in Lithuanian energy sector and Lithuania became dependent on electricity import. Natural gas consumption in its energy mix has increased for the production of electricity (Lithuania is totally dependent on imported natural gas from Russia) and the price of electricity for customers has increased by more than 30% [7].

The closure of Ignalina has strengthened the development of other energy infrastructure projects in Lithuania [8]. The high voltage grid interconnections with Poland and Sweden are underway and the first one will be opened in 2017. There are plans to build new nuclear power plant (Visaginas NPP) together with Latvia, Estonia and Poland in 2020. The strategic investor has been already selected in 2011.

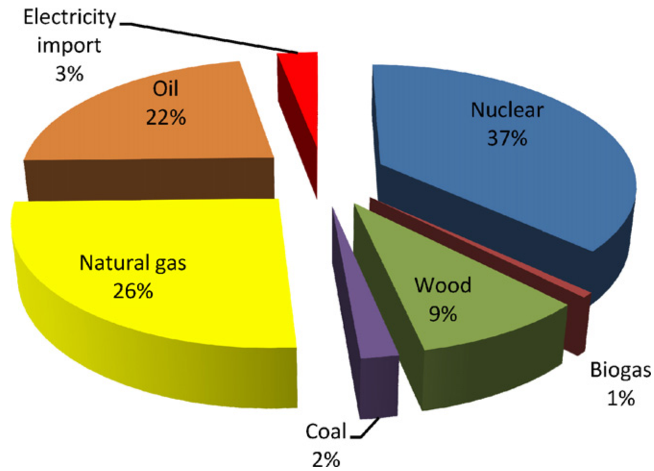


Fig. 1. The structure of primary energy supply in Lithuania in 2009 (in % of total TJ, 2009) [3].

Currently more than half of electricity is being imported. In the field of renewable energy resources Lithuania seeks to achieve the target of 23% of renewable energy in final energy consumption in 2020. For the electricity sector this means at least 20% (60% heat; 10% transport). The amount of electricity generation in 2010 has decreased to 4.71 TWh (2009: 13.5 TWh) and about 6 TWh had to be imported. The electricity import makes about 62% of the entire electricity demand. Currently in energy balance of Lithuania the most important energy sources are natural gas and oil, 42% and these fuels sources comes from only Russia. The supply of primary energy in Lithuania in 2009 is shown in Fig. 1 [7].

The biggest consumers of energy are transport. 34% of final energy consumption is utilized by this sector and more than 30% of energy is consumed by households sector. The share of industry is 18% of total final energy consumption. Final energy consumption by sectors is shown in Fig. 2 [7].

In Lithuania domestic energy resources represent only about 9% of the primary energy supply. In addition Lithuania has quite high energy intensity comparing with some new EU member states and with EU-27 average. In Fig. 3 the EU-27 average energy intensity and energy intensity development in Lithuania and other new EU member states are presented [7].

As one can see from Fig. 3 the energy intensity in Lithuania expressed in kgoe per 1000 EUR in prices of 2000 in Lithuania is higher than in Latvia and Poland however in other new EU member

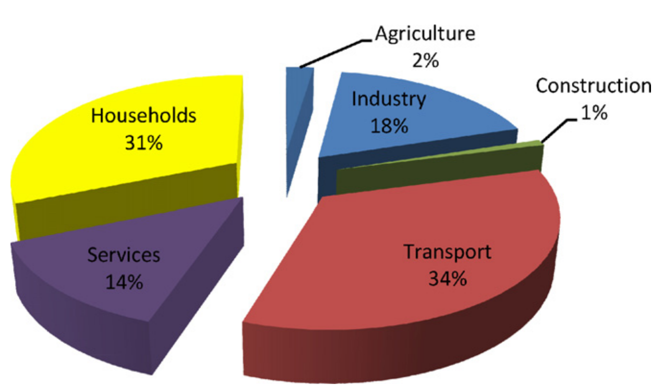


Fig. 2. The structure of final energy consumption in Lithuania in 2009 (in % of total TJ, 2009) [3].

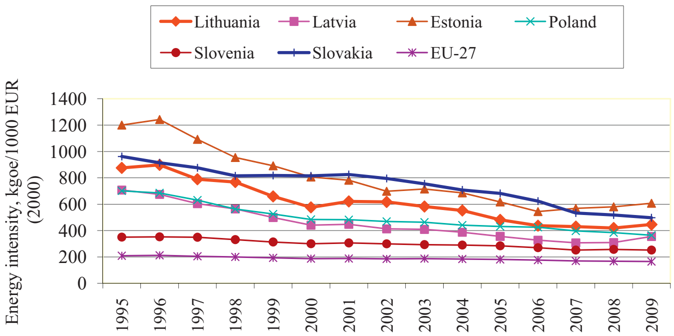


Fig. 3. Development of energy intensity in Lithuania, other new EU member states and EU-27 average.

states: Estonia, Czech Republic, Slovakia, and Slovenia energy intensity is even higher than in Lithuania.

Though primary and final energy consumption intensity has decreased approximately 50% during the period 1996–2009 energy intensity per unit of GDP is 2 times higher than the EU average. This reveals vast untapped potential for energy efficiency, especially in heating and transport sectors [9]. The positive trends of energy intensity reduction have changed since 2009 because crisis of 2007–2009 the energy consumption went down but for several sectors (services, households etc.) energy consumption is less elastic and energy consumption reduced less than GDP. In general, the overall energy intensity of the Lithuanian economy has been constantly decreasing until 2009, when it somehow increased [8].

During 1995–2010 Lithuania has implemented effective policies and measures to increase energy efficiency in each sector of economy. In the following chapter the policies and measures targeting energy intensity decrease in Lithuania will be analyzed.

4. Policies and measures targeting energy efficiency in Lithuania

The main policy document to promote energy efficiency in Lithuania is National Energy Efficiency Programme for 2006–2010 [9] approved by the Government of the Republic of Lithuania in 2007. It sets the following targets: renovation of buildings and updating their energy facilities increasing energy efficiency of energy production and use in all sectors, with special attention to district heating, industrial processes, household and transport sector; usage of renewable, local and secondary energy resources. There are also 2 Energy Efficiency Action Plans adopted in Lithuania pursuant to the provisions of Article 14(2) of Directive 2006/32/EC. The national energy savings target for a period of 9 years (2008–2016) set in the First Energy Efficiency Action Plan [10] equals 9% of the average final energy consumption in 2001–2005, which is 3797 GWh. The intermediate energy savings figure for a period of three years (2008–2010) is 1.5% of the average energy end-use in 2001–2005 and is equal to 628 GWh.

The Second Energy Efficiency Action Plan [11] adopted in 2011 describes the results of achieving the intermediate energy saving target for 2010. The Action Plan also presents an overview of the current energy consumption situation and describes newly adopted and envisaged energy efficiency measures aimed at the improvement of energy efficiency that must ensure the achievement of the national energy savings target for 2016. Further the impact of the main policies targeting energy savings in separate sectors will be assessed.

4.1. Household sector

Modernization of multi-apartment buildings is the main energy efficiency policy in household sector. It is expected to modernize at least 70% of all multi-apartment buildings and to reduce relative consumption of thermal energy per unit of the used dwelling area by up to 30%, compared with the year 2004. Energy savings targets for 2010 are 150 GWh if early actions are excluded [9]. During 2007–2008 period the investments in modernization of multi-flat buildings amounted to 58.8 mill. Lt and 480 buildings were renovated. The total energy savings make 13 GWh. From EU Structural Funds (2007–2013) 163.5 mill Lt were foreseen for multi-flat buildings renovation. Achieved energy savings due to renovation of 500 buildings until 2010 makes about 15.3 GWh [11,12].

The other measures such as design requirements, energy efficiency labeling for household appliances have also impact on energy savings in this sector however the impact on energy savings is unclear. There are other economic efficient measures to increase energy use efficiency in households. There is a huge energy saving potential in households sector which can be realized by implementing measures targeting behavioral changes toward sustainable energy consumption.

Resent research in this area identified energy saving potential households sector of Lithuania – which can be achieved at no costs [13]. During one month one household can achieve the following energy savings because of behavioral changes: electricity – 16,75 kWh, natural gas $-0.17\,m^3$ and 13.47 l of gasoline. Therefore the total energy saving potentail per month makes 0.011 toe and 0.132 toe per year. In 2010 there are 1.39 mill households in Lithuania and total energy saving potential due to behavioral changes in households sector of Lithuania makes about 0.18 Mtoe (2093 GWh). This is significantly higher than energy saving potential foreseen for this sector in Energy Efficiency Action plan. The measures targeting behavioral changes in energy consumption are: information campaigns on energy saving at no costs for households using mass media and social advertisement measures, establishment of institutions responsible for providing information on energy savings and conducting home energy audits on customers request, provision of tailored information and feedback based on home energy audits, setting more frequent and more informative energy bills for customers etc.

4.2. Service sector

Modernization and renovation of public buildings is implemented via different programs in Lithuania. 2004–2006 EU Structural Funds for energy use efficiency improvement in public buildings. The total energy savings makes about 5.5 GWh [10]. 2007–2013 EU Structural Funds (for reduction of energy consumption in public buildings). The energy savings targets for 2010–30 GWh, and for 2016–100 GWh. Achieved energy savings makes 46.7 GWh in 2010. The other programmes are [12]: Programme of renovation and reconstruction of science and studies institutions for 2007–2009; programme of renovation of university student halls; programme of renovation and provision with teaching aids of general education schools and vocational education and training; programme of renovation and upgrading of libraries for 2003–2013; programme of renovation of imprisonment institutions and humanization of imprisonment conditions for 2004–2009; programme of modernization of cultural centers for 2007–2020; programme of modernization of museums for 2007–2015; modernization of public buildings from special programme “Implementation of energy saving projects”; programmes of construction, reconstruction, repairs and material provision of municipal buildings used for educational, cultural, health care, social and other purposes; modernization of public buildings from

Table 1
Comparative assessment of policies and measures targeting energy efficiency increase in Lithuania in 2010.

	Policies and measures	Investments, mill Lt	The effect of policies and measures		
			Economic Efficiency (achieved energy savings compared with costs), kWh/Lt	Effectiveness (achieved energy savings), GWh	Efficacy (achieved savings compared with targets) %
1	Programme for modernization of multi-flat buildings (480 units)	58.8	0.22	13	
2	Modernization and renovation of multi-flat buildings from EU Structural Funds (500 units)	163.5	0.09	15.3	
3	The standard value added tax rate is 18%. Reduced 9% rate of VAT is applied to construction, renovation and insulation of residential houses	–	–	–	
4	Possible measures targeting behavioral changes in energy consumption	–	–	2000	
	Total in households sector	222	0.13	28	18.6
Service sector					
1	Modernization of public buildings from EU Structural Funds 2004–2006	130	0.11	3.5	
2	Modernization of public buildings from EU Structural Funds 2007–2013	513.7	0.09	46.6	
3	Programme of renovation and reconstruction of science and studies institutions	18	0.94	17	
4	Programme of renovation of university student halls	27	0.93	25	
5	Programme of renovation of general education schools and vocational education and training establishments	15	0.67	10	
6	Programme of renovation and upgrading of libraries	6.7	0.3	2	
7	Programme of renovation of imprisonment institutions and humanization of imprisonment conditions.	10		–	
8	Programme of modernization of cultural centers	15		–	
9	Programme of modernization of museums	13		–	
10	Modernization o public buildings from Special programme “Implementation of energy saving projects”	55		–	
11	Programmes of reconstruction and material provision of municipal buildings used for educational, cultural, health care etc.	66		–	
12	Modernization of public buildings from Lithuanian environmental investment fund	23.5		70	
	Total service sector	893	0.23	205	123
Industry					
1	Voluntary agreements	–	–	10.6	
2	Implementation of energy saving measures financed from EU Structural Funds	94	–	–	
	Total industry and construction	94	0.11	10.6	
Transport					
1	Improvement of road infrastructure	700	0.004	3	
2	The measures of public transport modernization	560	0.01	7	
	Total transport sector	1260	0.01	10	43.4
Energy sector					
1	EU Structural Funds for renovation modernization of energy infrastructure (2004–2006)	170	0.29	50	
2	EU Structural Funds for renovation modernization of energy infrastructure (2007–2013)	360		–	
3	Voluntary agreements with energy companies	–	–	100	
4	Measures to promote cogeneration including the feed-in tariffs for electricity purchase from CHP	–	–	–	
	Total in energy sector	530	0.28	150	32
	Total	2999	0.12	372.6	51

Lithuanian environmental investment fund. All these programmes have established energy saving targets. The targets, achieved results and investments are presented in Table 1.

Lithuanian Government order for mandatory inclusion of energy efficiency criteria in public procurement was approved on 2008. According to this order public institutions shall set minimum efficiency requirements in technical specifications (e.g., shall purchase fridges with no lower than A energy efficiency label). There are no clear data on achieved energy savings because of National Green Procurement Implementation Programme.

Total energy savings foreseen in Service sector according targets set by First Energy Efficiency Action plan during 2005–2020 makes 229 GWh. In 2010 – 85 GWh excluding early actions.

4.3. Industry and construction

First Energy Efficiency Action Plan approved in 2007 provided energy saving targets for the industrial sector which is not participating in the EU ETS system. This plan is directed toward the increase in energy end-use efficiency by making voluntary agreements with industry, and promotes the general heat and electricity production inside enterprises, and supports the audit services acquisition of energy end-use during the production processes. According First Energy Efficiency Action Plan the target for energy savings in industry is established just for 2016. There are no energy saving targets set for industry in 2010.

Voluntary agreements with enterprises and information programmes on energy efficiency shall lead to energy savings in industry. 3 enterprises in energy intensive industries: JSC “Akmenes cementas“, JSC “Lifosa” and JSC “Achema” have signed voluntary agreements with Ministry of Environment. Achieved electricity savings in these enterprises during 2007–2009 make more than 10 GWh [12].

There are financial measures to increase energy use efficiency in industry from EU Structural Funds. During 2007–2013 94 mill Lt are allocated from this measure from EU Structural Funds however there are no results about energy savings of implemented measures as the first call was initiated just in 2009.

From 2002 onwards, according to the Law on Environmental Pollution Charge of the Republic of Lithuania, natural persons and legal entities (industry, district heating companies), implementing environmental protection measures that reduce pollutant emissions into atmosphere from stationary pollution sources at least 5% calculating from the highest fixed permitted pollution standard, under the established procedure shall be exempt from pollution charge if pollutant amount is reduced by 5%. However the impact of this measure on energy savings in industry is not easy to assess [14].

4.4. Transport sector

Long term Lithuanian transport system development strategy up to 2025 sets the general direction and different targets of transport policy [15]. The strategy focus on road transport infrastructure and intermodal transport development. The following measures, such as how to improve the street network frames in the cities, modernize traffic control and management systems, develop modern tram networks in Vilnius and Klaipeda, extend contact networks in the larger cities with the developed trolleybus infrastructure, improve railway network infrastructure by reducing street/motorway loading with heavy vehicles thus minimization of pollution, are foreseen. The impact of road infrastructure improvement on energy savings make about 1 tne/100 km of renovated road. During 2008–2010 about 250 km roads were renovated. It makes about 3 GWh of energy savings [12].

The measures of modernization of public transport implemented during 2008–2009 in several municipalities (Akmenes, Siauliu and Vilnius) allowed to save 181 thou t of diesel or to achieve 2 GWh of energy savings [12]. Energy savings in “Lithuanian Railway” because of implemented modernization measures amounted to 5 GWh during 2007–2008 [12]. Tax exemption is applied for biofuels in Lithuania and the penetration of biofuels has almost doubled since 2005 however the energy savings due to penetration of biofuels are not assessed [16].

4.5. Energy sector

The following measures were applied to increase energy efficiency energy production sector [17]:

- Use of EU Structural Funds for modernization and refurbishment of energy supply networks and infrastructure. During 2004–2007 the achieved energy savings because of implemented measures financed from EU Structural Funds make about 50 GWh. However the data on energy savings because of implementation f measures financed from EU Structural Funds in 2008–2013 is not available yet.
- Voluntary agreements with energy companies. Planned energy savings in 2010 – 110 GWh, 2016 – 740 GWh. Starts in 2009 and ends in 2016.

Several measures are set forth for promotion of cogeneration. The share of CHP plants in the total electricity generation balance should reach 35% till 2025. At least 75% of district heat shall be generated at CHP till 2020. Planned energy savings in the Energy Efficiency Action plan amount to 0 GWh in 2010 and to 370 GWh in 2016 [10].

5. Comparative assessment of policies targeting energy efficiency in Lithuania

The State enterprise Energy agency has conducted report on energy savings during 2005–2010 period [13] however this report does not provide any analysis and comparisons of set targets by Energy Efficiency Action plan and achievements. The effect of specific policies is fragmentally presented however savings per sector are missing. Another study [12] performed by COWI also does not provide any assessments of effectiveness of implemented policies and measures in field of energy use efficiency improvement.

The evaluation of effectiveness, efficiency and efficacy of policies and measures is necessary seeking to monitor progress achieved and to recommend new polices [17,18]. For evaluating the success of policies regarding energy efficiency three main categories can be distinguished: effectiveness, efficacy and cost efficiency. The effectiveness of policies is determined mainly by whether the right targets were set and the right measures were taken. The achievement of the set targets shows the efficacy. The evaluation therefore should focus on those two issues to determine whether the attained impact relates to the desired effects. The overall goal of introducing policies is to reach targets in the most economical way. Regarding the evaluation this means that the measured effects should be weighed against the deployed means, which in most cases means the costs. In this regard it could be helpful to compare the results with costs for comparative assessment of policies and measures [19].

In Table 1 the effects of policies and measures are assessed in each sector in terms of effectiveness, economic efficiency and efficacy. Comparison of achieved energy savings allow to compare policies and measures in terms of effectiveness. The economic efficiency of these policies is assessed as ratio between achieved energy

savings and costs. The efficacy of policies and measures is assessed by comparing achieved energy savings with energy saving targets set for these sectors in First Energy Efficiency Action plan.

As one can see from Table 1 in terms of effectiveness the highest energy savings in 2010 were achieved by policies and measures implemented service sector (205 GWh) of Lithuania following by energy sector (150 GWh). The lowest energy savings were achieved by policies and measures targeting transport and industry sector.

In terms of cost efficiency the best results are achieved by policies and measures implemented in energy sector. The 1 LTL invested allowed to save 0.3 kWh of energy in this sector. In general economic efficiency of implemented energy efficiency policies in Lithuania is very low and makes on average 0.12 kWh/Lt. This means that the price of saved kWh of energy costs 8 Lt/kWh. The transport sector distinguishes with very low economic efficiency of implemented policies and measures – 0.01 kWh/Lt. Therefore the new cheaper policies and measures need to be implemented in Lithuania. In Table 1 the effect of probable policies and measures targeting behavioral changes toward sustainable consumption in households sector was evaluated. The total energy saving potential makes about 2000 GWh per year. This s huge potential which can be realized by cheap or even no cots measures and can generate money savings for households because of lower energy bills.

Evaluation of efficacy of implemented polices and measures revealed that policies and measures implemented in industry and service sector achieved the best performance in terms of efficacy.

The total energy saving target (726 GWh in 2010 excluding early actions) set in First Energy Efficiency Action plan for 2010–2016 was not implemented in 2010 (achieved savings make just 50% of the target set for 2010). Just in Service sector (which accounts just for 5% of total energy saving potential in 2010) the achieved energy savings in 2010 are higher by 205% comparing with target. In household sector (which accounts for 37% of total energy saving potential in 2010) because of faller of the programme of modernization of multi-flat buildings (renovated 980 buildings instead of 24,000) the achieved energy savings 28 GWh makes just 18.6% of targets set by action plan. In transport sector (which accounts for 9% of total energy savings) the achieved energy savings (10 GWh) make just 43% of targets set by action plan.

There were no energy saving targets set for industry sector in First Energy Efficiency Action plan for 2010. Achieved energy savings in industry in 2010 makes 10.6 GWh. Energy savings achieved in energy production sector (which accounts for about 40% of total energy savings in 2010) make about 32% of targets set by action plan for 2010. Therefore the best results of energy savings compared with set targets are achieved in service and industry sectors. The worst results are achieved in households and energy sector. The energy saving potential in these sectors makes about 80% of total energy saving potential set by First Energy Efficiency Action plan for 2010.

6. Conclusions

1. Though primary and final energy consumption intensity has decreased approximately 50% during the period 1996–2009 energy intensity per unit of GDP is 2 times higher than the EU average.
2. Lithuania has ambitious policy to increase energy use efficiency. The main policy document to promote energy efficiency in Lithuania is National Energy Efficiency Programme for 2006–2010. Implementation of First Energy Efficiency Action plan for 2010 provides for specific policies and measures and final energy saving targets for specific sectors of economy however the effect of specific policies is just fragmentally represented in various reports.
3. The comparative assessment of policies and measures is necessary seeking to monitor progress achieved and to select the best policies and to recommend new one. The effects of policies and measures in specific sectors were compared in terms of effectiveness, economic efficiency and efficacy. Comparison of achieved energy savings allow to compare policies and measures in terms of effectiveness. The economic efficiency of these policies is assessed as ratio between achieved energy savings and costs. The efficacy of policies and measures is assessed by comparing achieved energy savings with energy saving targets set for these sectors in First Energy Efficiency Action plan for 2010.
4. Assessment of efficacy of implemented policies and measures in 2010 revealed that the biggest energy savings were achieved in service sector (205 GWh) followed by energy sector (150 GWh) however the biggest potential energy savings are identified in households sector. The behavioral changes toward sustainable energy consumption allow to save about 2000 GWh per year. The achieved energy savings in households in 2010 because of renovation of multi-flat buildings make just 28 MWh.
5. In terms of cost efficiency the best results are achieved by policies and measures implemented in energy production sector. The 1 LTL invested allowed to save 0.3 kWh of energy in this sector. The transport sector distinguishes with very low economic efficiency of implemented policies and measures – 0.01 kWh/Lt. Therefore the new cheaper policies and measures needs to be implemented in Lithuania. The policies and measures targeting behavioral changes can achieve huge energy savings at no costs.
6. Assessment of efficacy of policies and measures indicated that achieved energy savings make just 50% of the target set by First Energy Efficiency Action plan for 2010. The best performing sectors in terms of efficacy were service and industry. In household sector the achieved energy savings makes just 18.6% of targets set by action plan. In transport the achieved energy savings make just 43% of targets set by action plan. There are no energy saving targets set for industry sector in First Energy Efficiency Action plan for 2010 however this sector achieved (10.6 GWh) the similar energy savings to transport sector (10 GWh).
7. The worst results in terms of efficacy are achieved in households and in energy sector. The energy saving potential in these sectors makes about 80% of total energy saving potential set by First Energy Efficiency Action plan for 2010 however the achieved energy savings makes just about 30% of the set targets for these sectors.
8. Policies targeting behavioral changes in household needs to be implemented in Lithuania seeking to energy saving targets at lower costs. These are information campaigns on energy saving for households using mass media and social advertisement measures, establishment of institutions responsible for providing information on energy savings and conducting home energy audits on customers request, provision of tailored information and feedback based on home energy audits, setting more frequent and more informative energy bills for customers etc.
9. The transport sector also needs more policies attention as this is the most energy intensive sector and implemented policies and measures showed the lowest economic efficiency. Lithuania obviously lacks effective policies and measures in this sector. The financial instruments to support use of hybrid and electric vehicles, measures to promote eco driving, and traffic management measures are necessary in Lithuania. The improvement of road infrastructure and public transport modernization are also promising.

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